ENGINE FUELS CONSISTING OF AN EMULSION COMPRISING MINERAL AND/OR NATURAL OILS, THEIR PREPARATION AND USE IN INTERNAL COMBUSTION ENGINE

Field of the invention

The present invention refers to new fuels representing an interesting alternative to the common fossil fuels being constituted of pyrolysis liquid emulsified with natural and/or mineral oils in the presence of emulsifiers and possibly co-emulsifiers. The invention refers also to the use of the above said fuels in internal combustion engines.

State of the art

In the last decade many studies have been performed with the aim of making available new fuels capable of replacing totally or at least in part the traditional fuels of fossil origin.

Possible substitutes of the common fossil fuels are in principle the liquids obtained by pyrolysis of biomass since they have a very low content of sulphur and therefore can be burnt without problem for the environment.

Unfortunately the oils obtained by pyrolysis contain a large amount of water (and also of acidic derivatives), are hard to ignite and present a low calorific value when compared to the fossil oils; therefore their use as such is practically impossible.

In view of the above said various works have been performed in order to realise mixture of pyrolysis liquids and the traditional fossil oils which could be industrially interesting and capable of substituting the traditional fuels.

EP-A-893 488 describes fuels in the form of pyrolysis liquid-in-diesel oil microemulsions consisting of diesel oil, pyrolysis liquid and at least an emulsifier with HLB between 4 and 18 derived from fatty acids and polyoxyethylene glycol, or fatty acids, sorbitol and polyoxyethylene or polyethoxylated alcohols with long aliphatic chains.

In spite of the good results obtained, as reported in the document, these fuels are still not completely satisfying since they require a high percentage of diesel oil in respect of pyrolysis liquid, the pyrolysis oil suitable for the preparation of the claimed microemulsions must have a limited content of water, they require the

formation of microemulsions and their stability strongly depends on temperature.

It is therefore evident how it is important to make available fuels which could be used in normal internal combustion engines consisting essentially of pyrolysis liquid and not presenting the above said drawbacks.

Detailed description of the invention

The present invention allows one to overcome the above said problems through the use of fuels consisting of emulsions of pyrolysis liquids, natural and/or mineral oils with emulsifiers and possibly co-emulsifiers capable of forming oil-in-water, water-in-oil emulsions or bicontinuous emulsions.

A pyrolysis liquid (or biooil) according to the invention is the oil obtained by burning organic materials deriving from different sources and technologies according to the known techniques.

These oils normally have a content of water comprised between 20 - 45% by weight and a pH of 2,3 - 3,4.

Mineral oils are the normal oils of fossil origin like, for example, gasoline, diesel, kerosene etc.

Natural oils are the oils normally deriving as by-products from the treatment of vegetables and other oil containing natural products.

The emulsifiers play the essential role for the preparation of the fuels according to the invention.

They are chosen in the group consisting of:

- non-ionic block-copolymers (or homopolymers) surfactants having HLB from 4 to 18 possibly in combination with non ionic surfactants (co-surfactants) with HLB from 4 to 18

and

- anionic block-copolymers (or homopolymers) surfactants having HLB 4 to 18 possibly in combination with cationic quaternary ammonium compounds.

Preferred emulsifiers of the fist group mentioned here above are:

Polyester/ether/ester block copolymers, (ABA form)

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Polyester/ester block copolymers, (AB form)
Polyalkylmetacrylate copolymers.
Preferred emulsifiers of the second group mentioned here above are:
Acrylic acid/ maleic acid copolymers (polycarboxylate),
Maleic acid/ olefin copolymers (polycarboxylate),
Maleic acid/ methylvinylether copolymers (polycarboxylate),
The above series crosslinked with a polyalkenyl polyether.

Quaternary ammonium compounds as defined here above are preferably mono-alkyl or di-alkyl ammonium chloride surfactants wherein the alkyl chains have from C8 to C22.

The surfactants are normally added in a quantity up to 3% by weight, calculated on the total of the emulsion.

According to the invention the use of the above said emulsifier allows to emulsify oils having a water content of 20 - 50%, moreover they allow the manufacture of fuels containing biooil in a range of 5 - 95% by weight calculated on the total fuel.

The fuel according to the invention present an exceptionally high stability (more than one month), their stability can even be improved by adding suitable co-surfactants.

As co-surfactants non ionic surfactants can be used according to the known techniques in order to adjust the emulsifier HLB value, and to improve the time stability of the resulting emulsion.

The co-surfactants are normally added in quantity comprised between 0,05 - 1,0% by weight calculated on the total weight of the fuel.

According to the invention the fuels can be prepared in three different kind of emulsion:

A) water-in-oil emulsion presenting a biooil/mineral or natural oil ratio of 1 - 45% (w/w)

bicontinuous emulsion presenting a biooil/mineral or natural oil ratio of 45 - 55% (w/w)

oil-in-water emulsion presenting a biooil/mineral or natural oil ratio of 55 - 99%

w/w.

The water-in-oil emulsions are prepared by adding a surfactant of the first group indicated above to hot mineral or natural oil and thereafter adding the biooil to the resulting mixture.

Bicontinuous emulsions were formulated by adding a surfactant of the first group to the mineral or natural oil, and to the biooil and then mixing together the resulting mixtures.

Oil-in-water emulsions were formulated by adding to the biooil a surfactant (which can be chosen both in the first or the second of the above-described groups) and thereafter adding to the resulting mixture the natural or mineral oil during emulsification.

The emulsification process was carried out by using a homogeniser.

The temperature during mixing was preferably maintained between 60 - 65°C and the emulsification was continued until a homogeneous single phase was obtained.

The emulsions are obtained at room temperature, too.

Example 1

Pyrolysis oils was obtained from DynaMotive Technologies Corporation (Canada) and ENEL (Italy). In table 1 are showed the characteristics of two different employed biooils.

Table1

Moisture content (%)	24.5	44.0
Ash (%)	0.03	0.28
Density (kg/l)	1.199	1.165
Viscosity (mPa s)		
@20°C	55	10
@50°C	11	4
Elemental		
Carbon	43.52	34.96
Hydrogen	6.31	5.94
Nitrogen	0.07	0.11
Sulphur	0.0	0.0
Oxygen (diff.)	50.07	58.71
HHV (MJ/kg)	16.9	16.5
Ph	2.4	3.0

Table 2 shows some formulations (one of each case) of prepared emulsions.

Table 2

Bio-Fuel (wt%)	Diesel (wt%)	Atlox 4912 (wt%)
25	74	1
49.5	49.5	1
75	24	1

The surfactant Atlox 4912 is a polyester/ether/ester block copolymer available from UNIQEMA.